

NON-PUBLIC?: N  
ACCESSION #: 9405260114  
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Waterford Steam Electric Station Unit 3 PAGE: 1 OF 7

DOCKET NUMBER: 05000382

TITLE: Relay Failure Causes Reactor Power Cutback & Subsequent  
Reactor Trip  
EVENT DATE: 04/26/94 LER #: 94-007-00 REPORT DATE: 05/26/94

OTHER FACILITIES INVOLVED: n/a DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 70

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION:  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:  
NAME: D.W. Vinci, Superintendent, Operations TELEPHONE: (504) 464-3178

COMPONENT FAILURE DESCRIPTION:  
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:  
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

#### ABSTRACT:

At 0808 on April 26, 1994, a Reactor Power Cutback and Turbine Setback to 50% governor valve position occurred while placing the Reactor Power Cutback system in service at 70% reactor power. An automatic reactor trip occurred approximately 2 minutes later due to a low Pressurizer Pressure Core Protection Calculator Auxiliary trip set at 1860 psia. The Reactor Power Cutback actuation was caused by the presence of an erroneous Feedwater pump 'B' trip input signal to the Reactor Power Cutback circuitry. The subsequent low Pressurizer pressure and reactor trip resulted from the cooldown induced by a mismatch between turbine power and reactor power following the Reactor Power Cutback. The root cause of the erroneous Feedwater pump 'B' trip input signal was found to be a failure of a Westinghouse model BFD44S non-safety relay which provides 'B' Feedwater pump trip status input to the Reactor Power Cutback circuitry. Immediate corrective actions included replacing the faulty relay and removing the Reactor Power Cutback system from service.

Subsequent corrective actions will include, in part, evaluations and enhancements along with event review by operations personnel. This event did not compromise the public health and safety.

END OF ABSTRACT

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Table "REQUIRED NUMBER OF DIGITS/CHARACTERS FOR EACH BLOCK" omitted.

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#### REPORTABLE OCCURRENCE

At 0808 on April 26, 1994, a Reactor Power Cutback and Turbine Setback to 50% governor valve position occurred while placing the Reactor Power Cutback system in service at 70% reactor power. An automatic reactor trip occurred approximately 2 minutes later due to a low Pressurizer Pressure Core Protection Calculator Auxiliary trip set at 1860 psia. The Reactor Power Cutback actuation was caused by the presence of an erroneous Feedwater pump 'B' trip input signal to the Reactor Power Cutback circuitry. The subsequent low Pressurizer pressure and reactor trip resulted from the cooldown induced by a mismatch between turbine power and reactor power following the Reactor Power Cutback. This event is thus being reported as an automatic Reactor Protection System (EIS Identifier JC) actuation under 10CFR50.73(a)(2)(iv).

#### INITIAL CONDITIONS

Plant Power 70 %  
Plant Operating Mode Mode 1; Power Operation  
Procedures Being Performed Specific to this OP-010-001, General Plant  
Event Operations  
OP-004-015, Reactor Power  
Cutback System  
OP-901-001, Reactor Power  
Cutback  
OP-902-000, Emergency Entry  
Procedure  
OP-902-001, Uncomplicated  
Reactor Trip Recovery  
Procedure.  
Technical Specification LCO's in Effect None  
Specific to this Event  
Major Equipment Out of Service Specific to None

this Event

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## EVENT SEQUENCE

(Times are approximate)

The Reactor Power Cutback System (RPCS)(No EIIS Identifier) is a control system designed to accommodate certain types of imbalances by providing step reduction in reactor power. The step reduction in reactor power is accomplished by the simultaneous dropping of one or more preselected subgroups of full length regulating Control Element Assemblies (CEAs)(EIIS Identifier AA-ROD) into the core. The RPCS also provides control signals to the Main Turbine (EIIS Identifier TA) to balance turbine and reactor power following the initial reduction in reactor power as well as to restore Steam Generator (EIIS Identifier AB-SB) water level and pressure to their normal controlled values. The system is designed to accommodate a loss of one Feedwater pump (EIIS Identifier SJ-P) or a large load rejection event.

At the time of an initiating event, the following control actions are generated by the Reactor Power Cutback System and transmitted to the Control Element Drive Mechanism Control System (CEDMCS) (EIIS Identifier AA) or the Main Turbine control system (EIIS Identifier TA): 1) Turbine setback to governor valve position equivalent to 50% turbine power; 2) Turbine runback to match turbine power and reactor power; 3) Turbine power increase inhibit, and 4) Selected CEA subgroup drop command.

At 0720 on April 26, 1994 Operations personnel began power ascension from 68% to 93% reactor power for post refueling reactor physics testing. At 70% reactor power procedure OP-010-001, General Plant Operations, instructs operations personnel to place the RPCS into service in accordance with OP-004-015, Reactor Power Cutback System. At 0808 while the Primary Nuclear Plant Operator was attempting to place the RPCS into service in accordance with section 6.1 of OP-004-015 a Reactor Power Cutback and Turbine setback occurred. There were no prior indications to alert the operator that a Cutback signal was present. The selected CEA subgroups 11 and 5,

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which are regulating groups 5 and 6, dropped into the core and the Main Turbine setback to a turbine load corresponding to 50% governor valve (EIIS Identifier TA-XCV) position (approx. 258 MWe) at a rate of 450%/min. The operating shift crew entered the Off-Normal operating

procedure OP-901-101, Reactor Power Cutback. A turbine runback (at 200%/min.) should have acted to further reduce turbine load, thus balancing turbine and reactor power.

It appears that the turbine runback associated with this transient was not adequate in reducing turbine load sufficiently to terminate the Reactor Coolant System (RCS) (EIS Identifier AB) cooldown. At approximately 0810, while the plant was in a transient condition, an attempt was made to further reduce turbine load to offset the observed dropping Pressurizer (EIS Identifier AB-PZR) pressure and level. At approximately 0811 low Steam Generator pressure pre-trips were received on all 4 channels of the Reactor Protection System (RPS) (EIS Identifier JC). The Shift Supervisor ordered a reactor trip but an automatic trip occurred before the reactor trip pushbuttons could be actuated. The reactor tripped on low Pressurizer Pressure Core Protection Calculator (CPC) (EIS Identifier JC-CPU) auxiliary trip of 1860 psia. The lowest Pressurizer pressure observed during this event was 1840 psia.

The operating shift crew immediately entered the Emergency Operating procedure OP-902-000, Emergency Entry Procedure. At approximately 0817 the operating shift crew entered OP-902-001, Uncomplicated Reactor Trip procedure. The plant was stabilized and recovery actions were completed. The operating shift crew exited the Emergency Operating procedures and entered the General Plant Operations procedure, OP-010-001 at approximately 0900.

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## CAUSAL FACTORS

Based on maintenance investigation it was discovered that the cause of the Reactor Power Cutback actuation was failure of a Westinghouse model BFD44S non-safety relay which provides 'B' Feedwater pump trip status input to the Reactor Power Cutback system circuitry. Although the relay was not energized, it was mechanically bound in the actuated state, thus sending a signal to the Reactor Power Cutback system circuitry which was representative of the Feedwater pump control oil low pressure switch actuations needed to cause a Reactor Power Cutback actuation. This actuation signal, due to the design of the RPCS, is not indicated in the main control room prior to placing the RPCS into service.

Based on preliminary failure analysis, the root cause of the relay failure is most likely attributed to mechanical binding caused by either wedged epoxy chips between the operating coil and plunger or by external pressure exerted on the coil by an adjacent coil (possibly due to thermal expansion) present in the ganged mounting configuration of the relays in

the Feedwater pump control cabinet.

The cause of the reactor trip was low Pressurizer Pressure CPC auxiliary trip. Coincident with the Reactor Power Cutback actuation, the turbine setback to approximately 258 MWe (approx. 24% turbine power based on post trip data) and reactor power had dropped to approximately 19% (from plant computer data) just prior to the reactor trip. The resulting mismatch between reactor and turbine power induced a RCS cooldown which lowered Pressurizer pressure to the CPC auxiliary trip setpoint of 1860 psia. The turbine power/reactor power mismatch resulted from an anomaly in the turbine runback function to sufficiently lower turbine power to terminate the cooldown. The specific turbine control system anomaly is presently under investigation.

The Westinghouse model BFD44S relays are commonly used in non-safety applications

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The Westinghouse model BFD44S relays are commonly used in non-safety applications throughout the plant. These relays are 'energize to trip' relays and remain energized for the entire duration of plant shutdowns. Extended periods with the relays in the energized state may accelerate the failure mechanism and may have contributed to the failure in this event.

The reliability feature of the 2 out of 2 input logic employed by the Reactor Power Cutback system for Feedwater pump lube oil pressure switches is defeated by utilizing a single actuating relay to provide an actuation input signal to the Reactor Power Cutback Module. This type of arrangement facilitates a single failure scenario in that a single relay failure can cause a Reactor Power Cutback signal to be generated. In addition, the Reactor Power Cutback system provides no advance status information prior to placing the system in service, in effect resulting in a 'set-up' situation for the operator.

#### IMMEDIATE CORRECTIVE MEASURES

Immediate corrective measures included a maintenance investigation of the erroneous Reactor Power Cutback, which resulted in the discovery and replacement of the faulty relay in the Feedwater pump control cabinet. Additionally, the Reactor Power Cutback System will remain out of service until adequate measures can be established to allow the control room staff to detect the presence of a Reactor Power Cutback signal or circuit malfunction prior to placing the Reactor Power Cutback System in service.

## ACTIONS TO PREVENT RECURRENCE

Actions to prevent recurrence include the following: (1) Identification of other similar relays and if any exist, evaluate their potential for affecting plant /system reliability; (2) Assessment of the overall response of the Reactor Power Cutback System as it responded in this event; (3) A review of this event by the Operations

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Superintendent with Operations personnel during licensed operator requalification training, reemphasizing the importance of taking conservative action to manually initiate Plant Protection functions prior to reaching automatic Plant Protection setpoints; and (4) Discussion or simulation of expected plant responses during Reactor Power Cutback at reduced power levels in Operator requalification training.

In addition to the preceding actions to prevent recurrence Waterford 3 has placed information related to this event on the Nuclear Network for dissemination to other utilities.

## SAFETY SIGNIFICANCE

Although this event was initiated by an erroneous Reactor Power Cutback input signal, the Reactor Protection System functioned as designed to provide an automatic reactor trip on low Pressurizer pressure CPC auxiliary trip of 1860 psia. This provided plant protection as required therefore the health and safety of the general public was not compromised.

## SIMILAR EVENTS

A similar event occurred on April 15, 1987 and was reported on Licensee Event Report 87-012. In this event the Reactor Power Cutback System was placed in service at approximately 50% reactor power with only one Feedwater pump in operation. The Reactor Power Cutback System requires that both Feedwater pumps be in service before placing the Reactor Power Cutback System in service. The control room staff took immediate action to reduce turbine load to minimum and withdraw CEAs in response to rapidly dropping Reactor Coolant System temperature and pressure. The ensuing transient led to an automatic reactor trip due to complications with steam generator levels. The root cause identified for this event was inadequate procedures.

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D.F. Packer  
General Manager  
Plant Operations  
Waterford 3

W3F1-94-0064  
A4.05  
PR

May 24, 1994

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, D.C. 20555

Subject: Waterford 3 SES  
Docket No. 50-382  
License No. NPF-38  
Reporting of Licensee Event Report

Gentlemen:

Attached is Licensee Event Report Number LER-94-007-00 for Waterford Steam Electric Station Unit 3. This Licensee Event Report is submitted in accordance with 10CFR50.73 (a)(2)(iv).

Very truly yours,

D.F. Packer  
General Manager  
Plant Operations

DFP/WHP/tjs  
Attachment

cc: L.J. Callan, NRC Region IV  
G.L. Florreich  
J.T. Wheelock - INPO Records Center  
R.B. McGehee  
N.S. Reynolds  
NRC Resident Inspectors Office

Administrator - LRPD

\*\*\* END OF DOCUMENT \*\*\*

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